

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT ENGINEERING AND PERMITTING DIVISION STATEMENT OF BASIS ANALYSIS Minor Revision Permit to Construct	PAGE 1	PAGES 28
	TV APPL. NO. 599116, 599117	DATE 5/23/18
	PROCESSOR Patrick Lee	REVIEWER

Facility Name: Air Products and Chemicals, Inc.
Facility ID: 101656
SIC Code: 2813

Equipment Location: 700 N. Henry Ford Avenue
 Wilmington, CA 90744

Mailing Address: 700 N. Henry Ford Avenue
 Wilmington, CA 90744

SCAQMD Contact Person: Patrick Lee
Phone Number: 909-396-2233
E-Mail Address: plee@aqmd.gov

1. INTRODUCTION/HISTORY AND SCOPE OF PERMIT

Air Products and Chemicals, Inc. (AP) operates an 88 MMSCFD capacity hydrogen production plant in Wilmington, CA. This plant was initially constructed in 1996 to supply hydrogen for the nearby Ultramar Refinery (currently Valero Wilmington Refinery) for use in its CARB Reformulated Fuels Program. Since construction, this plant (along with another hydrogen plant operated by AP in Carson, CA) now supplies hydrogen to many local refineries, including Valero, Tesoro, and Phillips 66. In addition to using commercial grade Natural Gas (NG), the AP Wilmington plant also receives refinery fuel gas from Valero as its feedstock to produce 99% purity hydrogen (H₂) using a process commonly known as Steam Methane Reforming (SMR).

This facility is subject to Title V requirements because it is a major source of criteria air pollutants (e.g. Reactive Organic Gases or ROG and nitrogen oxide or NO_x) as defined in Title V of the federal Clean Air Act and is subject to certain New Source Performance Standards (NSPS).

AP submitted the subject application to modify the Hydrogen Production Plant (P1/S1) by installing two additional compressors (D71) and two additional stanchions (loading arms and its support structure; D72). The additional equipment will enable the facility to meet the increase in demand of H₂ transportation fuel in the South Coast basin.

Recommended Action

This is a Minor permit revision because the proposed modification is not expected to result in any emission increases nor result in new or additional NSPS or NESHAP requirements pursuant to 40CFR Part 60 or 40CFR Part 61 or 63, respectively. A 45-day review period by the EPA is required. After the EPA review period is completed, issue a Permit to Construct for the Hydrogen Production Plant (Process 1, System 1) in Section H of the Title V permit under A/N 599116.

EQUIPMENT DESCRIPTION

APPLICATION NO. 599117
Application Submittal Date 11/21/17

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Title V Permit Revision Application

APPLICATION NO. 599116

Application Submittal Date 11/21/17

The following equipment under Process 1, System 1, will be moved from Section D to Section H of the facility permit. Proposed deletions are shown in ~~strikeouts~~ and proposed additions are underlined.

Equipment	ID No.	Connected To	RECLAIM Source Type / Monitoring Unit	Emissions And Requirements	Conditions
Process 1: HYDROGEN PRODUCTION PLANT (Refinery gas/Steam Reforming)					
System 1: HYDROGEN PRODUCTION – 88.0 MMSCFD Maximum Rated Capacity					S2.1, S13.1, S15.1, S31.1
VESSEL, V-119, FEED COMPRESSOR SUCTION, LENGTH: 11FT 4 IN; DIAMETER: 6 FT A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D1				
VESSEL, V-133, PROCESS OILY WATER, HEIGHT: 11 FT 10 IN; DIAMETER: 3 FT A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D2				E336.2
FILTER, X-110A/B, FEED GAS COMPRESSOR, 2 TOTAL, 20 CU.FT. CAPACITY EACH A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D3				
COMPRESSOR, C-101A/B, DUAL SERVICES, 2 TOTAL, 7,500 HP EACH WITH BUFFERED PACKING SEALS A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D4				E336.3
KNOCK OUT POT, V-131A/B, FEED INTERSTAGE, 2 TOTAL, HEIGHT: 9 FT; DIAMETER: 3 FT 6 IN; A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D8				
VESSEL, COALESCER, V-102A/B, FEED COMPRESSOR DISCHARGE, 2 TOTAL, HEIGHT: 5 FT; DIAMETER: 1 FT A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D12				
REACTOR, V-104, HYDROGENATION, WITH CHLORIDE GUARD, LENGTH: 20 FT; DIAMETER: 8 FT A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D14				
VESSEL, V-105A/B, FEED DESULFURIZER, 2 TOTAL, LENGTH: 19 FT; DIAMETER: 9 FT A/N: 561635 <u>599116</u> <u>Permit to Construct Issued: XX/XX/XX</u>	D15				

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ENGINEERING AND PERMITTING DIVISION**

STATEMENT OF BASIS ANALYSIS

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Equipment	ID No.	Connected To	RECLAIM Source Type / Monitoring Unit	Emissions And Requirements	Conditions
Process 1: HYDROGEN PRODUCTION PLANT (Refinery gas/Steam Reforming)					
REACTOR, H101, REFINERY GAS/STEAM REFORMING, TUBULAR TYPE A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D49				
REACTOR, V-109, HIGH TEMPERATURE SHIFT, LENGTH: 19 FT; DIAMETER: 11 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D18				
REACTOR, V-110, LOW TEMPERATURE SHIFT, LENGTH: 16 FT; DIAMETER: 11 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D22				
KNOCK OUT POT, V-112, COLD CONDENSATE, LENGTH: 11 FT 10 IN; DIAMETER: 7 FT 3 IN A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D27				
ADSORBER, X-101A-J, PRESSURE SWING ADSORPTION (PSA) UNIT, 10 TOTAL, DIAMETER: 10 FT 6 IN; HEIGHT: 21 FT 6 IN EACH A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D28				D90.3, E336.1
VESSEL, V-113A/B, PSA PURGE GAS, 2 TOTAL, DIAMETER: 12 FT; HEIGHT: 80 FT EACH A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D29				
HEATER, E-451, METHANATOR PRE-HEAT, 75 KW ELECTRICALLY HEATED A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D66				
REACTOR, V-451, METHANATOR, LENGTH: 5 FT ; DIAMETER: 4 FT 6 IN A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D67				
COOLER, E-455, PURE H2 PRODUCT CONDENSER, CRYOQUIP MODEL NO. VAI-1248-SSBL23, 0.092 MMBTU/HR, AMBIENT VAPORIZER A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D69				

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Equipment	ID No.	Connected To	RECLAIM Source Type / Monitoring Unit	Emissions And Requirements	Conditions
Process 1: HYDROGEN PRODUCTION PLANT (Refinery gas/Steam Reforming)					
VESSEL, V-452A/B, MOLECULAR SIEVE DRIER, WITH REGENERATION VENT TO ATMOSPHERE, 2 IN PARALLEL, LENGTH: 7 FT; DIAMETER: 2 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D70			CO: 2000 PPMV (5) [RULE 407, 4-2-1982]	D12.X, D28.X, D332.1, E191.X , E336.4, K67.X ,
*COMPRESSOR, E-453/454 K-123 A/B/C/D, PURE H2 PRODUCT, 2 4 TOTAL, 100 HP EACH A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D71				
LOADING ARM, H2 TRAILER, STANCHIONS A/B/C/D, PURE H2 PRODUCT, 2 4 TOTAL A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D72				
VESSEL, V-114, STEAM DEAERATOR, TWO SECTIONS, WITH UPPER SECTION VENTED TO ATMOSPHERE, LENGTH: 22 FT; DIAMETER: 9 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D31			CO: 2000 PPMV (5) [RULE 407, 4-2-1982]	D332.1
TANK, V-137, CONDENSATE BREAK, HEIGHT: 7 FT; DIAMETER: 6 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D32	C46		CO: 2000 PPMV (5) [RULE 407, 4-2-1982]	D90.4, E336.2
VESSEL, V-107, BLOWNDOWN, LENGTH: 11 FT 4 IN; DIAMETER: 4 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D33				
VESSEL, V-108, STEAM, HEIGHT: 50 FT; DIAMETER: 9 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D34				
VESSEL, V-129, INTERMITTENT BLOWDOWN, VENTED TO ATMOSPHERE, HEIGHT: 11 FT 4 IN; DIAMETER: 4 FT A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D35			CO: 2000 PPMV (5) [RULE 407, 4-2-1982]	D332.1

** The compressor ID designations are being corrected to match AP's current internal plant ID designations*

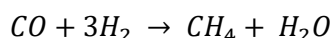
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Equipment	ID No.	Connected To	RECLAIM Source Type / Monitoring Unit	Emissions And Requirements	Conditions
Process 1: HYDROGEN PRODUCTION PLANT (Refinery gas/Steam Reforming)					
CONDENSER, E-130, SURFACE, LENGTH: 32 FT; DIAMETER: 8 FT 8 IN A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D36				
TURBINE, T-101, STEAM, GENERAL ELECTRIC, DOUBLE EXTRACTION, NON-FIRED TYPE WITH A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D37				
GENERATOR, ELECTRIC, 31.9 MW FUGITIVE EMISSIONS, MISCELLANEOUS (PUMPS, COMPRESSORS, VALVES, FLANGES, PRV) A/N: 561635 599116 <u>Permit to Construct Issued: XX/XX/XX</u>	D52				H23.2

2. PROCESS DESCRIPTION

In order to provide hydrogen transportation fuel to the LA region, Air Products conducted a project to modify the Wilmington Hydrogen Plant by installing the H2 filling station (devices D66 through D72, P1/S1) under PC 547681. The project was completed and put into operations in 2015. The system was eventually issued a Permit to Operate under A/N 561635 in July, 2016. The H2 filling station further purifies the hydrogen product exiting the Pressure Swing Adsorption (PSA) unit to produce ultra-high purity H2 for use as transportation fuel, which is delivered to fueling stations via high-pressure-mobile-fill trailers. The methanator reactor V-451 (device D67) was designed and constructed to produce up to 2 MMSCFD of transportation fuel, but compressors (D71) and stanchions (D72) were purposely sized to handle a loading capacity of only 1 MMSCFD based on demand at the time. By adding two additional compressors and two additional stanchions, the facility's loading capacity for ultra-high purity H2 will increase from 1 MMSCFD to 2 MMSCFD.

The hydrogen product stream exiting the PSA unit contains CO at a concentration of roughly 30 ppm and is unfit to be used as transportation fuel. Methanator reactor V-451 (device D67) further processes a small portion (up to 2 MMSCFD) of that stream to produce ultra-high purity H2 (containing <1 ppm of CO) for use as transportation fuel. The methanator reactor removes CO from the PSA product stream through the following reaction:



Methanation Reaction

The purified hydrogen exiting the methanator reactor is routed to the methanator drier, which removes any moisture in the hydrogen prior to compression and loading into delivery trailers. The drier consists of two molecular sieve beds in parallel to remove moisture. One bed is used to dry the hydrogen product while the

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other bed is being regenerated or sits as stand-by. During regeneration, the “saturated” bed is heated while pure hydrogen product is passed through the vessel and vented to the atmosphere at an estimated maximum flowrate of 14,000 SCFH. The regeneration process takes approximately 14 hours to complete (6 hours of heating followed by a maximum 8 hours of atmospheric venting, as permitted by condition **E336.4**). Post-construction source testing of the drier regeneration vent in 2015 (full report contained in application folder for A/N 547681) demonstrates that the regeneration stream being vented to the atmosphere contains the following concentration of pollutants:

- CO (average <0.1 ppmv)
- CH₄ (average ~5.4 ppmv)
- VOC (average ~1.6 ppmv)

The methanator drier regeneration vent is the only point of emissions for the H₂ filling station system. The methanator drier is permitted to have regeneration events no more than once per day, as per condition **E336.4**. At the current methanator operation of 1 MMSCFD, the methanator drier was expected to require regeneration once per month, but in practice the drier has only required regeneration once every six months. Nevertheless drier regeneration is conservatively estimated to double to twice per month when the methanator is operating to produce 2MMSCFD.

After methanation and drying, the ultra-high purity hydrogen is directed to four compressors (device D71; two existing and two being added under the subject application) rated at 100 HP each, compressed to 53 MPa (523 atm), and loaded into delivery trailers via loading arms/stanchions (device D72; also with two existing and two being added under this application). The delivery drivers loading the H₂ product into the trailers sample every load for moisture content. If the moisture content in the H₂ transportation fuel reaches or exceeds 5 ppm, the plant is notified so switching of the drier beds and regeneration of the “saturated” bed can take place. However, Air Products has indicated that regeneration events have so far been conducted about once every six months, before the 5 ppm threshold is reached (i.e. to be safe and to exercise the regeneration process/system), because actual required regeneration frequency is much less than expected.

The two new compressors (K-123 C/D) will be paired with two existing compressors (K-123 A/B) to make two independent compressor trains. All four compressors will be modified with a control valve on the recycle line to allow them to slowly ramp on and off, decreasing any potential impact to the main hydrogen plant operations. The two trains will be connected to all four loading stanchions (A/B/C/D), allowing for the ability to fill up to two trailers simultaneously, with two additional trailers hooked up and queued for filling. Stanchion D will have a low-pressure fill line which will allow for filling of low pressure mobile-fill trailers.

Methanator Drier Regeneration – Potential for Vented Hydrogen to Ignite and Combust

Pure hydrogen is extremely flammable, with a Lower Explosive Limit (LEL) of 4% and an Upper Explosive Limit (UEL) of 75%. The vent gases (primarily pure H₂ with trace amounts of CO, CH₄, and VOC as mentioned above) being vented to the atmosphere during methanator drier regeneration has the potential to combust if electrostatic discharges are generated at the vent outlet. The combustion of vent gases at the outlet can generate thermal NO_x emissions.

Air Products proposes to equip the regeneration vent outlet with a toroidal ring to eliminate the potential for ignition. The current outlet is a conventional type with sharp turns and edges that can induce static

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discharges as vent gases exit the outlet. Static discharges can provide enough energy to cause the hydrogen in the vent gases to ignite (a hydrogen-air mixture has a minimum ignition energy of about 0.02 millijoules¹). The toroidal ring is a “donut”-shaped attachment with no sharp edges and will be smoothly welded onto the vent outlet to minimize the potential for static discharge. The manufacturer/vendor for the toroidal ring, Zeeco, has indicated that the hydrogen exit velocity (~ Mach 0.06) for this type of application is considered low and the likelihood of auto-ignition from static discharges at this velocity is very unlikely. The toroidal ring is expected to provide an additional layer of protection against static discharge at the vent outlet to prevent combustion (ie; NOx generation). Please see Section 7 below for calculation of hydrogen exit velocity.

Air Products also proposes to install a FlameGard® 5 UV/IR-H2 Flame Detector to monitor and detect for hydrogen flames in the unlikely event ignition does take place at the vent outlet during drier regeneration. Hydrogen flames are pale blue in color, and are nearly invisible to the naked-eye during daytime hours. The FlameGard® 5 Flame Detector is a UV/IR camera that monitors infrared and ultraviolet radiation at specific wavelength ranges to detect the presence of a hydrogen flame. According to the manufacturer’s literature, “this combination of IR and UV detection improves false alarm immunity, while producing detectors that can detect even small hydrogen fires at a range of 5m.”

In conjunction with the UV/IR camera, Air Products proposes to implement control logic to automatically shut off the flow of hydrogen to the drier beds if a flame is detected at the outlet during drier regeneration. If a flame is detected, the system is designed to shut off the flow of hydrogen within 30 seconds to extinguish the flame (a 20 second delay to prevent triggering a false alarm, and a conservative 10 seconds to completely halt the process). Hydrogen flow will be shut off by closing upstream valves HV-8052 and HV-8053. After the flame is extinguished, Air Products may reattempt to regenerate the drier beds by reintroducing hydrogen flow, or they may suspend the regeneration process until another day, when atmospheric conditions are more favorable.

The combined installation of a toroidal ring for ignition prevention along with a UV/IR camera and automated control logic for flame detection and elimination, respectively, are expected to prevent and/or minimize combustion during methanator drier bed regeneration events. Pursuant to **K67.X**, Air Products will be required to collect post-modification regeneration event data to demonstrate the effectiveness of the toroidal ring and/or the UV/IR camera and control logic combination in terms of ignition prevention and NOx emission mitigation, respectively. Air Product’s electronic data historian will record pertinent parameters (at a frequency of once per minute) to determine if combustion of vent gases occurs, and if so, the duration of the presence of a flame at the regeneration vent outlet. The data will be evaluated and NOx emissions, if any, will be calculated in the PC to PO evaluation.

3. CONSTRUCTION AND PERMITTING HISTORY

The AP Wilmington facility’s Title V permit was last renewed on March 13, 2015. Table 1 below provides a brief permitting history of Process 1, System 1.

¹ Ayumi Kumamoto *et al* 2011 *J. Phys.: Conf. Ser.* **301** 012039

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Table 1 – Permit History for Process 1, System 1 (Hydrogen Production Plant)

Application No. [Permit No.]	Date Received Or (Issued)	Application Type	Purpose
599116	11/28/17	50	Submitted application to modify the hydrogen plant by installing two additional compressors for D71 and two additional stanchions to H2 filling station loading arm D72 to increase loading capacity from 1 MMSCFD to 2 MMSCFD of ultra-high purity H2 transportation fuel.
562543 ¹	3/20/14	60	Submitted application for Change of Condition (CofC) pursuant to HB Case No. 4276-14 to increase CO test frequency for V-137 vent from every 5 years to 1 year until two successive test results 10 months apart demonstrate compliance. A/N 562543 was not needed (cancelled) because the requested CofC was made under A/N 561635.
561635 [G42061]	3/20/14 (PO 7/29/16)	50	Submitted application to modify the hydrogen plant by rerouting the atmospheric vent of V-137 to the flare.
554971	8/05/13 (3/13/15)	74	Title V facility permit renewal.
547681 ²	2/26/13 (PC 1/2/14)	50	Submitted application to modify the hydrogen plant by installing methanator to purify product hydrogen and loading equipment to supply up to 1 MMSCFD of ultra-high purity hydrogen for use as transportation fuel.
310073 [G15792]	12/26/95 (PC 3/20/96)	50	Submitted application before construction was completed to modify (add condensate break tank V-137) and change condition to the PC issued on 9/9/94 for initial construction of the hydrogen plant.
293114	5/23/94 (PC 9/9/94)	10	Submitted application for initial construction of new hydrogen plant.

(1) Application cancelled

(2) Application for A/N 561635 was submitted before issuance of PO for A/N 547681. The application for A/N 547681 was therefore cancelled and the PO for the subject equipment was issued under A/N 561635

4. REGULATORY APPLICABILITY DETERMINATION

Applicable legal requirements for which the proposed equipment is required to comply with are identified in the Title V permit (for example, Sections D, E, and H of the proposed Title V permit). The SCAQMD has evaluated the applicable requirements for the proposed equipment and determined that it complies with all applicable rules and regulations. The following describes the applicable federal and non-federally enforceable rules and requirements for the proposed equipment. Versions of District rules that are federally enforceable are denoted by amendment or adoption dates in bold font, whereas versions that are non-federally enforceable are not.

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PART I: SCAQMD REGULATIONS

Rule 212:	Standards for Approving Permits and Issuing Public Notice
Amended 12/07/95, 06/05/15	<p>Pursuant to subparagraphs (c)(1), (c)(2), and (c)(3) of Rule 212, respectively, public notice is required for a project if any new or modified permit units are located within 1000 feet of a school, if any new or modified facility has on-site emission increases exceeding any of the daily maximums specified in subdivision (g) of Rule 212, or if any new or modified permit units have an increase in toxic air contaminants that results in an increase of maximum individual cancer risk (MICR) of more than one in a million (1×10^{-6}) during a lifetime (70 years).</p> <p>Based on the following reasons, this project did not trigger the public noticing requirement of this rule:</p> <ul style="list-style-type: none"> • The permit unit has not been relocated and is beyond 1000 feet from the outer boundary of the nearest school. • There are no emission increases expected with this project. • There is no increase in health risk expected with this project. <p>Hence, public notice is not required.</p>

Rule 401:	Visible Emissions
Amended 03/02/84, 11/9/01	<p>This rule specifies that a person shall not discharge into the atmosphere any air contaminant from any single source of emission for a period or periods aggregating more than three minutes in any one hour which is as dark or darker in shade as the designated No.1 on the Ringelmann chart or of such opacity that it obscures an observer's view to an equal or greater level. This is equivalent to opacity of 20%.</p> <p>The hydrogen production plant is not expected to cause visible emissions under normal operation. Note that operation of the H2 filling station, since constructed in 2014, has not resulted in any visible emission violations. Additionally, condition E336.4 will be amended to limit venting of H2 during regeneration to only daytime hours after sunrise and before sunset, such that there will be no visible flames in the unlikely event that vent gases combust. Therefore, the proposed modifications are not expected to cause visible emissions. Continued compliance is expected.</p>

Rule 402:	Nuisance
Adopted 05/07/76	<p>This rule specifies that a person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which cause, or have a natural tendency to cause injury or damage to business or property.</p> <p>The hydrogen production plant does not have a history of nuisance problems. The proposed modification is not expected to cause nuisance. Continued compliance is expected.</p>

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Rule 407:	Liquid and Gaseous Air Contaminants
Amended 04/02/82	<p>This rule contains an emission limit for carbon monoxide (CO) of 2,000 ppm by volume on a dry basis, discharged into the atmosphere from any piece of equipment. This rule also contains an emission limit for sulfur compounds which would exist as liquid or gas at standard conditions, calculated as sulfur dioxide (SO₂), of 500 ppm by volume, from any piece of equipment. Emissions from stationary internal combustion engines, propulsion of mobile equipment, or emergency venting due to equipment failure or process upsets are exempt from these limits. Additionally, equipment which is subject to the emission limits and requirements of source specific rules in Regulation XI, or equipment which complies with the gaseous fuel sulfur content limits of Rule 431.1, are exempt from the SO₂ emission limits of this rule.</p> <p>As previously stated, the methanator drier regeneration vent is the only source of emissions for the H₂ filling station. Source testing performed in 2015 has demonstrated that CO emissions from the methanator drier are less than 0.1 ppmvd during regeneration events. This is well below the maximum allowable concentration of 2,000 ppm. Additionally, there are no sulfur (SO₂) emissions associated with this equipment. The drier is tagged with D332.1, which requires monitoring at least once every 5 years to demonstrate compliance with the CO emission limit of this rule.</p> <p>The proposed modification is not expected to result in any noticeable change in CO emissions and will be verified by post-modification source testing pursuant to condition D28.X. Continued compliance is expected.</p>

Rule 1173:	Control of Volatile Organic Compound Leaks and Releases from Components at Petroleum Facilities and Chemical Plants
Amended 02/06/09	<p>This rule is applicable to all components at refineries, chemical plants, lubricating oil and grease re-refiners, marine terminals, oil and gas production fields, natural gas processing plants and pipeline transfer stations. A list of exempted components can be found in 1173(l).</p> <p>Components for which this rule is applicable are subject to the following requirements:</p> <ul style="list-style-type: none"> • 1173(d) – Leak Standards • 1173(e) – Identification requirements • 1173(f) – Inspection requirements • 1173(g) – Maintenance requirements • 1173(h) – Atmospheric PRD requirements • 1173(i) – Recordkeeping and reporting requirements <p>AP Wilmington is subject to this rule for equipment in the plant which contacts refinery fuel gas. The rest of the plant is not subject to the requirements of Rule 1173 per 1173 (l)(1)(D), as these components handle fluids with a VOC content of less than 10% by weight. Generally, components upstream of the reformer reactor are subject to Rule 1173 because they contact refinery fuel gas, while components downstream of the reformer are <i>not</i> subject to Rule 1173 because the hydrocarbons in the refinery fuel gas have been converted to hydrogen in the reformer reaction.</p>

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	<p>Since the equipment for the H2 filling station are all located downstream of the reformer reactor, they do not come in contact with fluids that have a VOC content greater than 10% by weight and are not considered to be in VOC service. As such, the new fugitive components for this project are not subject to Rule 1173. Continued compliance for all affected equipment upstream of the reformer reactor is expected since no changes are being made to those equipment.</p>
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Rule 1189:	Emissions From Hydrogen Plant Process Plants
Amended 01/21/00	<p>The purpose of this rule is to reduce emissions of VOC from hydrogen plant process vents. The rule applies to all hydrogen plants that produce any hydrogen for use in petroleum refining operations.</p> <p><u>1189(c)(3) – Requirements for Existing Hydrogen Plants</u></p> <p>This subpart requires that the total VOC emissions from all process vents at a hydrogen plant to be less than 2.5 lbs of VOC per MMSCF H2 produced. Compliance with this subpart is determined by conducting an annual source test, as per 1189(e).</p> <p>The last annual Rule 1189 source test for AP Wilmington was performed in 2013. At the time, the vent from process condensate break tank V-137 (D32, P1/S1) was the only remaining process vent (as defined by 1189(b)(5)) at the AP Wilmington plant after the condensate stream from V-137 was rerouted to the sewer (away from the cooling tower). After issuance of PC 561635 in 2014, which re-routed the tank V-137 vent to the existing clean service flare (C46, P3/S1), AP Wilmington no longer contained any process vents. Therefore, no Rule 1189 annual source tests have since been performed.</p> <p>Construction for the H2 filling station (devices D66 - D72) under A/N 547681 was completed in 2015. Of these devices, the methanator drier vent to atmosphere (D70) was the only <i>potential</i> process vent. Post-construction source testing performed by AKI in 2015 indicated that VOC emissions from the drier vent were essentially non-existent, at a maximum concentration of 2.6 ppmv. As shown in Section 7, maximum PTE VOC emissions, assumed to be in the form of methanol, are calculated to be 0.025 lb/day. Since the plant is capable of producing over 80 MMSCFD of hydrogen product, the methanator drier is expected to contribute less than 0.0003 lb VOC per MMSCF of hydrogen produced, assuming that regeneration occurs on a daily basis (maximum permitted frequency per condition E336.4). This is negligible compared to the allowable plant-wide emission ratio of 2.5 lb VOC/MMSCF H2.</p> <p>It was stated in the PC to PO evaluation for A/N 561635 that the drier vent could be excluded from Rule 1189 annual testing if subsequent source tests validated the findings of the first source test performed in 2015. However, no subsequent annual tests have been performed because all other process vents had already been eliminated or re-routed to control. Therefore, for this project, AP Wilmington will be required to perform post-modification source testing for device D70, per condition D28.X, to determine VOC emissions from the drier vent. If the test results confirm that there are no VOCs present in the vent stream, the methanator drier vent may be excluded from annual Rule 1189 source testing, and therefore, condition D28.X will be removed at that time.</p> <p><u>1189(e)(1-5) – Monitoring, Reporting, and Recordkeeping Requirements</u></p>

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	As mentioned above, the last annual Rule 1189 source test for AP Wilmington was performed in 2013. The 2013 source test report is currently being reviewed by District Source Test Engineering (STE) staff. Although it is still pending approval, the source test report indicates that the Wilmington plant will have no compliance issues with this rule (preliminary calculation of 0.045 lb VOC/MMSCF H2). Note that prior annual Rule 1189 source test reports that have been reviewed/approved by STE have shown that the facility has had no issue in complying with the emissions limit of this rule. Continued compliance is expected.
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REG XIII	New Source Review (NSR)
1301	General
Amended 12/07/95	<p>This rule is applicable to any installation of a new source and to modifications of existing sources which may cause the issuance of any nonattainment air contaminant, Ozone Depleting Compounds (ODCs), or ammonia at a facility. The South Coast Air Basin is currently in nonattainment for VOC, NO_x, SO_x, PM₁₀ and PM_{2.5}.</p> <p>The methanator drier vent is the only potential source of emissions from this proposed modification. Based on the post-construction source test for the H2 filling station under PC to PO evaluation for A/N 547681, the drier vent only emits CO, CH₄, and VOC during regenerations. CO and CH₄ (not defined as a VOC per Rule 102 but is a GHG) are not subject to this rule but will be evaluated under Reg XVII. Therefore, only VOC (methanol) emissions from the drier vent will be evaluated under this regulation.</p> <p>The proposed modification to the H2 filling station system is not expected to result in an emission increase (greater than 1.0 lb/day) of any nonattainment pollutants, but may be considered an NSR event due to the definition of "modification," as per 1302(x). Therefore, analysis of Rule 1303 is included below for completeness.</p> <p>Note that Air Products is required by condition D28.X to perform a post-modification source test to verify that this project did not result in an increase in VOC emissions.</p>
1303	Requirements
Amended 05/10/96, 12/06/02	<p><u>1303(a)(1) - Best Available Control Technology (BACT)</u></p> <p>According to SCAQMD BACT Guideline, BACT is required if the uncontrolled emission increases resulting from installation of new equipment, or from relocation or modification of existing equipment, is greater than one (1.0) pound per day.</p> <p>BACT is not required because the proposed modification is not expected to result in an increase of VOC emissions greater than one pound per day. Compliance is expected.</p> <p><u>1303(b)(1) - Modeling</u></p> <p>The applicant must substantiate with modeling that the new facility or modification will not cause a violation, or make significantly worse an existing violation of any state or national ambient air quality standards at any receptor location in the District. According to 1306(b), the new total emissions for modified sources shall be calculated on a pound per day basis for determination of BACT and modeling applicability.</p> <p>Modeling is not required for VOCs, as specified in Appendix A of this rule.</p>

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	<p><u>1303(b)(2) - Emission Offsets</u></p> <p>Unless exempt from offset requirements pursuant to Rule 1304, emission increases shall be offset by either Emission Reduction Credits (ERC) approved pursuant to Rule 1309, or by allocations from the Priority Reserve. Per District policy, offsets are required for any increase in emissions that is greater than or equal to 0.42 <i>lb/day</i> on a 30-day average basis. It is also District policy that offsets are calculated on a project basis. Since the refinery is located in the South Coast Air Basin (SOCAB), an offset ratio of 1.2-to-1.0 is required. As such, the trigger for emission offsets is effectively any increase that exceeds 0.42 <i>lb/day</i> ($0.42 \times 1.2 = 0.504$ which is > 0.50).</p> <p>This project is not expected to result in an increase of VOC emissions equal to or greater than 0.42 <i>lb/day</i>. Therefore, ERCs are not required.</p> <p><u>1303(b)(4) - Facility Compliance</u></p> <p>The District's compliance records do not indicate that Air Products has any outstanding problems relating to compliance with applicable rules and regulations of the District. Continued compliance is expected.</p> <p><u>1303(b)(5) - Major Polluting Facilities</u></p> <p>Any new major polluting facility (source) or major modification at an existing major polluting facility (source) must comply with the requirements of 1303(b)(5)(A-D)</p> <p>This project is not expected to result in an emissions increase (greater than 1 <i>lb/day</i>) and is not considered a major modification as per 1302(r). Therefore, the requirements of this subsection do not apply. Compliance is expected.</p>
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Rule 1401	New Source Review of Toxic Air Contaminants
Amended 09/01/17	<p>This rule is applicable to new, relocated, or modified permit units which emit any toxic air contaminants (TACs) listed in Table 1 of this rule.</p> <p>During regeneration, the drier vent has the potential to emit VOC, likely to be methanol (MeOH), which is classified as a TAC. The requirements of this rule are therefore applicable to this permit unit.</p> <p><u>1401(d) – Requirements</u></p> <p>This subpart requires that the cumulative increase in maximum individual cancer risk (MICR) from a project cannot be greater than one in a million (1.0×10^{-6}). This rule also requires that the cumulative increase in total chronic hazard index and the cumulative increase in total acute hazard index (HI) for any target organ system shall not exceed 1.0 for any project.</p> <p>The TAC emissions for the methanator drier passed a Tier 1 health risk screening, so MICR can be assumed to be less than 1.0×10^{-6}. As shown in Table 3 in the <i>Emissions Calculations</i> section, the chronic/cancer and acute pollutant indexes are both well below 1.0. Compliance is expected.</p> <p>Note that Air Products is required by condition D28.X to perform a post-modification source test for the methanator drier. The results of this source test will be used to</p>

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	verify that the project did not result in an increase in TAC emissions that would alter this rule compliance determination.
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REG XVII	Prevention of Significant Deterioration (PSD)
	<p>The PSD program is the federal New Source Review (NSR) program for pollutants for which an area is in attainment with or unclassified with respect to a National Ambient Air Quality Standard (NAAQS), as well as greenhouse gases (GHG). The SOCAB is currently designated as attainment with NAAQSs for CO, NO_x, SO_x, and lead. Therefore, CO, NO_x, SO_x, lead compounds, and GHGs must be evaluated under this regulation.</p> <p>Regulation XVII contains preconstruction review requirements for modifications which result in a significant emission increase at an existing major stationary source. The proposed modification is not expected to result in an increase of emissions for CO or GHGs greater than the significance thresholds listed in 1702(s), and the hydrogen production plant (P1/S1) is not defined as a major stationary source per 1702(m). Therefore, PSD requirements do not apply to the proposed modification and further analysis under regulation XVII is not required.</p> <p>Note that Air Products is required by condition D28.X to perform a post-modification source test for the methanator drier. The results of the source test will be used to verify that PSD pollutants from the project do not exceed PSD Significance Thresholds. Compliance is expected.</p>

REG XX	Regional Clean Air Incentives Market (RECLAIM)
	<p>RECLAIM is a market incentive program designed to allow facilities flexibility in achieving emission reduction requirements for Oxides of Nitrogen (NO_x) and Oxides of Sulfur (SO_x). AP Wilmington is currently in RECLAIM for NO_x and first entered RECLAIM as a Cycle 2 facility on June 30, 1999.</p> <p>The subject hydrogen production equipment is not expected to generate emissions of either NO_x or SO_x and is therefore not subject to any RECLAIM requirements. Nonetheless, Air Products will make provisions at the methanator drier regeneration system as part of this project to minimize the potential for hydrogen combustion at the vent outlet to mitigate thermal NO_x emissions. Pursuant to condition K67.X, AP Wilmington is required to provide data to substantiate the effectiveness of this system prior to the issuance of the PO. In the event this system is not effective in preventing/mitigating hydrogen combustion, NO_x emissions will be calculated and evaluated for RECLAIM applicability/compliance during the PC to PO conversion stage. Continued compliance is expected.</p>

REG XXX	Title V Permits
Amended 11/05/10	The Title V Permit system is the air pollution control permit system required to implement the federal Operating Permit Program as required by Title V of the federal Clean Air Act as amended in 1990. This regulation defines permit application and issuance procedures as well as compliance requirements associated with the program.

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STATEMENT OF BASIS ANALYSIS

**Minor Revision
Permit to Construct**

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AP Wilmington was issued an initial Title V permit effective 2/2/09. The facility operated under the provision of an application shield pursuant to Rule 3002(b) from 2/1/14 through 3/12/15 while its renewal application as being processed. The renewed Title V permit was issued on 3/13/15 with a new expiration date of March 12, 2020.

The Permit to Construct for modification of the Hydrogen Production Plant (P1, S1) will be issued as a revision of the Title V permit. Permit revisions are categorized into the following four types: *administrative, minor, de minimis significant and significant*. The review and distribution requirements for each revision type are summarized in the table below.

Title V Permit Revisions: Review and Distribution Requirements

Revision Type	EPA Review (45-day)	Public Notice (30-day)	Send Final Permit to EPA
Administrative	No	No	Yes
Minor	Yes	No	Yes
De Minimis Significant	Yes	No	Yes
Significant	Yes	Yes	Yes

According to the definition of 3000(b)(15), a minor permit revision means any Title V permit revision that:

- (A)
- (i) does not require or change a case-by-case evaluation of reasonably available control technology (RACT) pursuant to Title I of the federal Clean Air Act; or maximum achievable control technology (MACT) pursuant to 40 CFR Part 63, Subpart B;
 - (ii) does not violate a regulatory requirement
 - (iii) does not require any significant change in monitoring terms or conditions in the permit;
 - (iv) does not require relaxation of any recordkeeping, or reporting requirement, or term, or condition in the permit;
 - (v) does not result in an emission increase of RECLAIM pollutants over the facility starting Allocation amount which has previously undergone a significant permit revision process;
 - (vi) does not result in an increase in emissions of a pollutant subject to Regulation XIII – New Source Review or a hazardous air pollutant;
 - (vii) does not result in an increase in GHG emissions of >75,000 tpy CO₂e;
 - (viii) does not establish or change a permit condition that the facility has assumed to avoid in applicable requirement;
 - (ix) is not an installation of a new permit unit subject to a New Source Performance Standard (NSPS) pursuant to 40 CFR Part 60, or a National Emission Standard for Hazardous Air Pollutants (NESHAP) pursuant to 40 CFR Part 61 or 40 CFR Part 63; and,
 - (x) is not a modification or reconstruction of an existing permit unit, resulting in new or additional NSPS or NESHAP requirements; or,.

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	<p>(B) incorporates an existing general permit, as defined in subdivision (e) of Rule 3004, and its associated requirements, into another Title V permit.</p> <p>Because the proposed modification is not expected to result in an increase of any HAPs or pollutants subject to Reg. XIII, trigger any new NSPS or NESHAP requirements or result in an increase in GHG emissions greater than 75,000 tpy, this application qualifies as a Title V Minor Revision. This means that EPA review of the draft permit is required, per Rule 3003(j)(1)(A). Public review is not required, per 3006(b). A copy of the final permit will be submitted to the EPA within 5 working days of its issuance, per Rule 3003(j)(1)(E). Compliance with Reg. XXX is expected.</p>
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Part II: STATE REGULATIONS:

CEQA	California Environmental Quality Act																
Amended 01/01/05	<p>CEQA requires that the environmental impacts of proposed projects be evaluated and that feasible methods to reduce, avoid, or eliminate identified significant adverse impacts of these projects be considered. According to the District’s CEQA Guidelines, the net emission increase thresholds for significant effect are:</p> <table><tr><td>NOx</td><td>55 lb/day</td><td>SOx</td><td>150 lb/day</td></tr><tr><td>VOC</td><td>55 lb/day</td><td>CO</td><td>550 lb/day</td></tr><tr><td>PM10</td><td>150 lb/day</td><td>Lead</td><td>3 lb/day</td></tr><tr><td>PM2.5</td><td>55 lb/day</td><td></td><td></td></tr></table> <p>The proposed modification is not expected to result in any emission increase which exceeds the significance thresholds listed above.</p> <p>Note that Air Products had previously submitted a CEQA review checklist for the initial construction of the H2 filling station system at the Wilmington plant (PC 547681), which found that CEQA analysis was not required. If the modification proposed under this application is evaluated cumulatively with the previous project, the only items that are affected on the 400-CEQA form include:</p> <ul style="list-style-type: none">• (c)(3) – Will there be any demolition, excavating, and/or grading construction activities that encompass an area exceeding 20,000 square feet?• (c)(10) – Will the project result in an increase in heavy-duty transport truck traffic to and/or from the facility by more than 350 truck round-trips per day? <p>For question/item (c)(3), the CEQA review checklist submitted for PC 547681 estimated that the H2 filling station system required a total excavation area of 9,106 ft². Of this total area, the compression skid required 288 ft² and the filling stanchion area required 7,500 ft². The proposed modification to add two additional compressors and filling stanchions can be assumed to require the same area of excavation (an additional 7,788 ft²). Therefore, the total footprint of the H2 filling station system is assumed to be 16,894 ft² and does not trigger further CEQA review.</p> <p>For question/item (c)(10), Air Products estimates that the increased production and loading capacity of hydrogen transportation fuel (due to the proposed modification) will</p>	NOx	55 lb/day	SOx	150 lb/day	VOC	55 lb/day	CO	550 lb/day	PM10	150 lb/day	Lead	3 lb/day	PM2.5	55 lb/day		
NOx	55 lb/day	SOx	150 lb/day														
VOC	55 lb/day	CO	550 lb/day														
PM10	150 lb/day	Lead	3 lb/day														
PM2.5	55 lb/day																

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	<p>increase mobile-fill trailer round-trips from 8 times per day, to a maximum of 14 times per day. As a more conservative approach, it can be estimated that trailer round-trips will double from 8 to 16 times per day, since loading capacity will be doubled from 1 to 2 MMSCFD of H2 transportation fuel due to this project. In either case, the expected number of mobile-fill trailer round-trips is much lower than the 350 round-trip threshold, and does not trigger further CEQA review.</p> <p>Air Products marked “No” to all of the additional criterion which may trigger CEQA on the submitted 400-CEQA form for this project. With no other significant environmental impacts expected, <u>CEQA analysis is not required for this application.</u></p> <p>A copy of the CEQA review checklist submitted for PC 547681 is contained in the application folder.</p>
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Part III: FEDERAL REGULATIONS

40CFR 60	STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES
Subpart VVa:	Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry for Which Construction, Reconstruction, or Modification Commenced After November 7, 2006
	This plant only produces hydrogen, which is not considered a synthetic organic chemical as per §60.489, and is therefore not subject to the requirements of Subpart VVa. The proposed modification will not effect this compliance determination.
Subpart GGGa	Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries for Which Construction, Reconstruction, or Modification Commenced After November 7, 2006
	The Air Products hydrogen plant is not subject to these petroleum refinery-specific regulations. The plant is subject to (and in compliance with) the equipment leak standards in District Rule 1173 for equipment upstream of the reformer reactor only. The proposed modification will not effect this compliance determination.

40CFR 68	CHEMICAL ACCIDENT PREVENTION PROVISIONS
	Part 68 sets out the requirements for owners or operators of stationary sources concerning the prevention of accidental releases. This plant is subject to the requirements of this rule. This part requires eligible facilities to submit a Risk Management Plan (RMP) to the EPA. Facility condition F24.1 requires Air Products to submit statements (including any relevant EPA certification of its RMP) as part of an annual compliance certification process. Air Products is currently in compliance with this condition, as they have submitted annual statements since construction certifying that they are in compliance with all requirements of this subpart. Continued compliance is expected.

5. MONITORING AND OPERATIONAL REQUIREMENTS

Compliance Assurance Monitoring (CAM)

Applicable monitoring and operational requirements for which the H2 filling station system is required to comply with are identified in the Title V permit by the tagging of the conditions shown in the Equipment Description section of this SOB. These conditions are part of the proposed permit that will be listed under Process 1, System 1 in Section H of the Title V facility permit. The monitoring and operational requirements pursuant to these conditions are shown in Section 10 of this SOB. The Compliance Assurance

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Monitoring (CAM) requirements of 40CFR Part 64 are not applicable to Hydrogen Production Plant because the permit unit does not utilize any control devices to achieve compliance with any applicable emissions limitations or standards, and emissions are well below major source thresholds.

6. PERMIT FEATURES

Permit Shield

A permit shield is an optional part of a Title V permit that gives the facility an explicit protection from requirements that do not apply to the facility. A permit shield is a provision in a permit that states that compliance with the conditions of the permit shall be deemed compliance with all identified regulatory requirements. To incorporate a permit shield into the Title V permit involves submission of applications for change of conditions for each of the equipment affected by the permit shield. Permit shields are addressed in Rule 3004 (c). This facility has not applied for a permit shield.

Streamlining Requirements

Some emission units may be subject to multiple requirements which are closely related or redundant. The conditions may be streamlined to simplify the permit conditions and compliance. Emission limits, work practice standards, and monitoring, recordkeeping, and reporting requirements may be streamlined. Compliance with a streamlined condition will be deemed compliance with the underlying requirements whether or not the emission unit is actually in compliance with the specific underlying requirement. This facility has not applied for any streamlined conditions.

7. EMISSIONS AND HEALTH RISKS

As mentioned above, the methanator drier regeneration vent is the only potential point of emissions for the H₂ filling station system. The drier has the potential to emit CO, CH₄, and VOC while venting to the atmosphere during regeneration. The drier also has the potential to emit NO_x only if the vented gases combust. As mentioned earlier, Air Products will install a toroidal ring at the vent outlet and implement control logic to prevent and immediately mitigate NO_x emissions, respectively, in the unlikely event that hydrogen combustion occurs.

The methanator drier's potential to emit is calculated using worst-case scenarios for regeneration frequency, venting duration, venting flowrate, and pollutant concentrations. Note that although the regeneration frequency is expected to double to twice per month as mentioned above, it is still much lower than what was conservatively permitted by condition **E336.4** (regeneration up to once per day) when the H₂ filling station was initially constructed. Therefore, the PTE for the H₂ filling station is not expected to change. However, condition **E336.4** will be edited to clearly define the drier's maximum venting duration during regeneration to prevent an increase in PTE (this was inadvertently omitted during PC 547681). Additionally, Air Products is required by condition **D28.X** to perform a post-modification source test to verify that the newly installed equipment will not result in an increase in emissions of CO, CH₄, or VOC.

Although this project is not expected to increase the methanator drier's maximum potential to emit, emissions for CH₄ and VOC have been recalculated with different emission factors and are different from baseline emissions (values from engineering evaluations for PC 547681 and PO 561635). See below for the parameters that were used to calculate the methanator drier's potential to emit for this statement of basis:

- Maximum venting flowrate of 14,000 SCFH
- Maximum venting duration of 8 hours per day (limit being added to **E336.4**)

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- Maximum venting frequency of once per day (already limited by **E336.4**)
- CO concentration of 1 ppm (H2 transportation fuel spec: <1 ppm)
- CH4 concentration of 55 ppm (estimation from PC 547681)
- VOC concentration of 2.6 ppm (highest value from 2015 source test)
- Global warming potential (40 CFR Part 98, Table A-1): 1 lb CH₄ = 25 lb CO₂-equivalent (CO₂e).

Please see below for sample calculations. Methanator drier PTE emissions are summarized in Table 2 below.

Maximum Flowrate of Vented Gases during Drier Regeneration

The maximum vent gas flowrate during regeneration was initially estimated by Air Products to be 14,000 SCFH during initial construction of the H2 filling station in 2015. However, post construction source test measured the flowrate to be only 5,300 SCFH. To determine which value is more representative moving forward for this project, the District requested Air Products to calculate flow based on process parameters and in-line orifice plate dimensions, which are summarized below. The maximum vent flowrate was calculated to be 12,225 SCFH.

- Maximum Inlet Pressure (pressure setting of PSV on the incoming feed line to the methanator skid; P₁) = 950 psig
- Discharge pressure (P₂) = 0 psig
- Inlet Temperature (T₁) = 540F
- Outlet Temperature (T₂) = 375F
- Pipe Inner Diameter (D) = 1.939 inches (2" Schedule 80S Pipe)
- Orifice Inner Diameter (d) = 0.078 inches
- Beta Ratio (β) = 0.0402

The calculation performed by Air Products' in-house program utilizes iterative steps to calculate flow based on correlations for classic fluid mechanic arrangements found in *Pipe Flow: A Practical and Comprehensive Guide*, by Rennels and Hudson. However, the program and specific equations used are proprietary, and presenting the iterative steps would be difficult, so the applicant has provided "hand calculations" consisting of a single iteration instead. The hand calculations utilize similar principles as the program calculations, but relies on Darcy-Weisbach head loss equations, resistance coefficients for sharp-edged orifices located in straight pipes, and jet velocity ratios (the latter two defined in *Pipe Flow*) in order to estimate molar flowrate. However, the Darcy-Weisbach equations are only meant to be used with incompressible fluids (whereas hydrogen gas is a compressible fluid).

The applicant has also provided sample calculations for flow of compressible fluids through a straight pipe (no orifice, and different parameters from the regeneration vent) which shows that use of iterative calculations can allow for hydrogen to be treated as a pseudo-incompressible fluid to be used with the Darcy-Weisbach equations. The results of these sample calculations demonstrate that calculations performed with a higher number of iterations generate lower molar flowrate values, for cases of hydrogen flow that are similar to the regeneration vent for this application. Therefore, the maximum hydrogen flowrate of 12,225 SCFH, as calculated through iterative steps by Air Product's in-house program, should be acceptable as a representative value. However, the maximum vent flowrate is conservatively assumed to remain as 14,000 SCFH for PTE calculation purposes. The hand calculations and sample iterative calculations are contained in the application folder for reference.

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Note that the subject modification being evaluated in this statement of basis is not expected to affect the maximum potential flowrate of vented gases during drier regeneration.

Maximum Velocity of Vented Gases during Drier Regeneration

The maximum velocity of gases exiting the regeneration vent outlet is calculated from the maximum flowrate of 14,000 SCFH. The pipe outlet will have an inner diameter of 1.939 inches once the existing fitting is replaced by a toroidal ring. Note that the flowrate of 14,000 SCFH is for standard conditions (14.7 psia, 68°F) and needs to be converted into the actual flowrate based on pressures and temperatures at the vent outlet before exit velocity can be determined.

$$n = \frac{PV}{RT} \quad \text{Where:} \quad P = 101325 \text{ Pascal} \quad R = 8.314 \text{ m}^3\text{PaK}^{-1}\text{mol}^{-1}$$

$$V = 1 \text{ m}^3 \quad T = 375\text{F} = 463.7\text{K}$$

$$\text{So, } n = \frac{101325 \times 1}{8.314 \times 463.7} = 26.28 \text{ moles H}_2$$

$$\text{density} = \rho = \frac{26.28 \text{ moles H}_2}{1 \text{ m}^3} \times 2.016 \frac{\text{grams H}_2}{\text{mole H}_2} \times \frac{1 \text{ lb}}{454 \text{ grams}} \times \frac{1 \text{ m}^3}{35.31 \text{ ft}^3} = 0.0033 \frac{\text{lb H}_2}{\text{ft}^3}$$

$$14,000 \frac{\text{scf}}{\text{hr}} \times \frac{1 \text{ hr}}{3,600 \text{ s}} \times \frac{1 \text{ lbmol}}{379 \text{ scf}} \times \frac{2.016 \text{ lb H}_2}{\text{lbmol H}_2} = 0.02069 \frac{\text{lb H}_2}{\text{second}}$$

$$0.02069 \frac{\text{lb H}_2}{\text{second}} \times \frac{1 \text{ ft}^3}{0.0033 \text{ lb H}_2} = 6.26 \frac{\text{ft}^3}{\text{s}} = Q_{\text{volumetric}}$$

$$\text{exit velocity} = \frac{6.26 \frac{\text{ft}^3}{\text{s}}}{(1.939 \text{ inch} \times \frac{1 \text{ ft}}{12 \text{ inch}})^2 \times \frac{\pi}{4}} = \boxed{305.3 \frac{\text{feet}}{\text{second}}}$$

Speed of Sound & Mach Number

$$\text{Speed of sound} = a = \sqrt{\frac{kg_c R^* T}{MW}}$$

Where: k = specific heat ratio = 1.41 for H₂ [dimensionless]
 g_c = 32.2 lbm-ft/lbf-sec² R^* = gas constant = 1545.35 ft-lbf/lbmol-°R
 MW = molecular weight = 2.016 lbm/lbmol T = 375F = 834.7°R

$$\text{So: } a = \sqrt{\frac{1.41 \times 32.2 \times 1545.35 \times 834.7}{2.016}} \approx 5,400 \frac{\text{feet}}{\text{second}}$$

$$\text{Mach Number} = M = \frac{v}{a}$$

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Where: v = velocity of object

a = speed of sound of medium through which object is traveling

$$M = \frac{305.3 \text{ fps}}{5,400 \text{ fps}} = 0.0565 \approx 5.7\% \text{ Mach}$$

Note that although the gases vent to atmosphere (air), the speed of sound for hydrogen is utilized to calculate the Mach number. This calculation methodology has been accepted by the toroidal ring manufacturer/vendor, Zeeco.

CO Emissions

Post-modification PTE CO emissions remain the same as pre-modification PTE CO emissions. CO emissions due to vented gases are calculated using a concentration of 1 ppm, which is the maximum allowable concentration of CO for H2 transportation fuel. Note that source test conducted in 2015 resulted in a CO concentration of 0.1 ppmv in the vent gases, well below the fuel spec of 1 ppm.

$$\frac{1 \text{ ppmv CO}}{10^6} \times \frac{28 \text{ lb CO}}{\text{lbmol CO}} \times \frac{14,000 \text{ scf}}{\text{hr}} \times \frac{1 \text{ lbmol}}{379 \text{ scf}} \times \frac{8 \text{ hr}}{\text{day}} \times \frac{365 \text{ day}}{\text{yr}} \times \frac{1 \text{ ton}}{2,000 \text{ lb}} = \boxed{0.0015 \text{ tpy CO}}$$

GHG Emissions

As per Rule 102, methane (CH4) is not defined as a VOC. However, it is a greenhouse gas (GHG) that is subject to PSD.

PTE GHG emissions for this statement of basis have been re-calculated using an updated global warming potential (GWP) value for CH4 that is higher than values used in previous evaluations. It was previously recognized that 1 pound of methane was equivalent to 21 pounds of carbon dioxide (1 lb CH4 = 21 lb CO2e), but this GWP value was amended in 2014 to recognize that 1 pound of methane is equivalent to 25 pounds of carbon dioxide (1 lb CH4 = 25 lb CO2e).

$$\frac{55 \text{ ppmv CH}_4}{10^6} \times \frac{16 \text{ lb CH}_4}{\text{lbmol CH}_4} \times \frac{25 \text{ lb CO}_2\text{e}}{1 \text{ lb CH}_4} \times \frac{14,000 \text{ scf}}{\text{hr}} \times \frac{1 \text{ lbmol}}{379 \text{ scf}} \times \frac{8 \text{ hr}}{\text{day}} \times \frac{365 \text{ day}}{\text{yr}} \times \frac{1 \text{ ton}}{2,000 \text{ lb}} = \boxed{1.189 \text{ tpy CO}_2\text{e}}$$

VOC Emissions

The 2015 source test utilized SCAQMD Method 25.3 to determine VOC emissions but did not identify which compounds were present as VOC. Based on our knowledge of the process, it was assumed that the VOC is methanol, which is both a volatile organic compound and a toxic air contaminant that is generated upstream of the methanator (at the shift reactors).

The current baseline VOC emissions (from PO 561635) were calculated using a concentration of 1.6 ppm (average from the 2015 source test report). However, PTE for VOC has been recalculated for this statement of basis by using a concentration of 2.6 ppm, which was the highest recorded value during the source test.

Additionally, baseline VOC emissions were calculated with the flowrates recorded during the 2015 source test (82 scfm or 4920 SCFH) and with the assumption that the regeneration stream is vented to the

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atmosphere for 24 hours per day. For this statement of basis, VOC emissions have been recalculated with a maximum venting flowrate and venting duration of 14,000 SCFH and 8 hours per day, respectively, to be consistent with the calculation methodologies for CO and GHG emissions.

$$\frac{2.6 \text{ ppmv MeOH}}{10^6} \times \frac{32.04 \text{ lb MeOH}}{\text{lbmol MeOH}} \times \frac{14,000 \text{ scf}}{\text{hr}} \times \frac{1 \text{ lbmol}}{379 \text{ scf}} \times \frac{8 \text{ hr}}{\text{day}} = \boxed{0.0246 \text{ lb/day MeOH}}$$

Table 2 – Methanator Drier Vent Maximum PTE

Air Pollutant	lb/hr	lb/day	lb/yr	tpy
CO	0.001	0.0083	3.02	0.0015
GHG (as CO ₂ e)	0.271	6.501	2373	1.189
VOC (as MeOH)	0.003	0.0246	8.99	0.0045

TAC Emissions and Health Risks

Methanol is the only toxic air contaminant (TAC) that is expected to be emitted during regeneration of the methanator drier. As previously discussed, methanol is both a VOC and a TAC, so therefore, VOC and TAC emissions are identical for this evaluation.

Table 3 – Rule 1401 Tier 1 Health Screening Analysis

TAC	10/2/15 Source Test – Maximum Concentration/Emissions			Rule 1401 Screening Emission Level @ 25 Meters		Pollutant Screening Index	
	ppm	lb/hr	lb/yr	Acute (lb/hr)	Cancer/ Chronic (lb/yr)	Acute (lb/hr)	Cancer/ Chronic (lb/yr)
Methanol (methyl alcohol)	2.6	0.0246	8.99	6.18E+00	1.44E+05	3.99E-03	6.24E-05

The application for A/N 599116 was deemed complete on 12/07/17, so version 8.1 of SCAQMD's Rule 1401 Risk Assessment Calculator was utilized to perform a health risk assessment for the proposed modifications to the H2 filling station. As shown in Table 3 above, the TAC emissions from the methanator drier passed a Tier 1 screening analysis; therefore, no further screening/health risk analyses are required.

8. COMPLIANCE HISTORY FOR THE LAST TWO YEARS

A review of the facility's compliance status for the past 2 years shows that AP Wilmington has been issued zero Notices of Violation (NOV) and one Notice of Compliance (NC). The NC has been resolved, and is marked as "INCOMP" in the District's CLASS database.

9. COMPLIANCE CERTIFICATION

By virtue of the Title V permit application and issuance of this permit, the reporting frequency for compliance certification for the facility shall be annual.

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10. CONDITIONS TO BE IMPOSED

A/N 599116:

CONDITIONS:

System Conditions:

S2.1 The operator shall limit emissions from this system as follows

CONTAMINANT	EMISSION LIMIT
VOC	Less than 2.5 lbs / mmscf of hydrogen produced

A totalizing flow meter shall be installed and maintained to accurately indicate and record the flow rate of hydrogen produced.

[RULE 1189, 1-21-2000]

[Systems subject to this condition: Process 1, System 1]

S13.1 All devices under this system are subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
VOC	District Rule	1189

[RULE 1189, 1-21-2000]

[Systems subject to this condition: Process 1, System 1]

S15.1 The vent gases from all affected devices of this process/system shall be vented as follows:

All vent gases shall be directed to the flare system except Device IDs D31, D35, and D70 that vent to the atmosphere.

This process/system shall not be operated unless the flare system is in full use and has a valid permit to receive vent gases from this system.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(b)(2)-Offset, 5-10-1996]

[Systems subject to this condition: Process 1, System 1]

S31.1 The following BACT requirements shall apply to VOC service fugitive components associated with the devices that are covered by application number(s) 310073, 310075 & 293123:

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All new components in VOC service as defined in Rule 1173, except valves and flanges, shall be inspected quarterly using EPA reference Method 21. All new valves and flanges in VOC service, except those specifically exempted by Rule 1173, shall be inspected monthly using EPA Method 21.

All new components in VOC service, except pressure relief devices for which a leak in excess of 200 ppmv shall be repaired within 5 days of detection, a leak greater than 500 ppmv but less than 1,000 ppmv, as methane, measured above background using EPA Method 21 shall be repaired within 14 days of detection. Components shall be defined as any valve, fitting, pump, compressor, pressure relief valve, diaphragm, hatch, sight-glass, and meter, which are not exempted by Rule 1173.

All new valves greater than 2-inch size and major components in VOC service as defined by Rule 1173, except those specifically exempted by Rule 1173, shall be distinctly identified from other components through their tag numbers (e.g., numbers ending in the letter "N"), and shall be noted in the records.

All new valves in VOC service, except those specifically exempted by Rule 1173, shall be bellows seal valves for 2-inch and smaller sizes, except as approved by the District, in the following applications: heavy liquid service, control valve, instrument piping/tubing, applications requiring torsional valve stem motion, applications where valve failure could pose safety hazard (e.g., drain valves with valve stems in horizontal position), retrofits/special applications with space limitations, and valves not commercially available.

If 98.0 percent or greater of the new valve and the new flange population inspected is found to leak gaseous or liquid volatile organic compounds at a rate less than 500 ppm for two consecutive months, then the operator shall revert to a quarterly inspection program with the approval of the executive officer. This condition shall not apply to bellow sealed valves.

The operator shall keep records of the monthly inspection (and quarterly where applicable), subsequent repairs and reinspections, in a manner approved by the District.

[RULE 1303(a)(1)-BACT, 5-10-1996]

[Systems subject to this condition: Process 1, System 1, 2; Process 3, System1]

Device Conditions:

D. Monitoring/Testing Requirements

D12.X The operator shall install and maintain a(n) ultraviolet/infrared flame detector to accurately indicate the presence of a flame at the regeneration vent outlet.

For the purposes of this condition, the presence of a flame is defined by an ALARM (20 mA) signal from the detector.

The operator shall also install and maintain a device to continuously record the parameter being measured.

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[RULE 401, 3-2-1984; Rule 401, 11-9-01; RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997]

[Devices subject to this condition: D70]

D28.X The operator shall conduct source test(s) in accordance with the following specifications:

The test shall be conducted at the vent outlet during the first drier regeneration following startup of this equipment, after the new compressors K-123 C/D (for D71) and new loading arm stanchions C/D (for D72) are put in operation to up to produce 2 MMSCFD of high purity H₂, while H₂ product is being vented.

The District shall be notified of the date and time of the test at least 10 days prior to the test.

The test shall determine and report the concentrations, in parts per million, and mass emission rates, in pounds per hour, for CO, CH₄, and VOC according to an SCAQMD approved source test protocol.

A source test report shall be submitted to SCAQMD no later than 60 days after the source test is completed.

[RULE 1301(b)(1) - NSR Applicability, 12-7-1995; RULE 1703 - PSD Analysis, 10-7-1988; RULE 1714 - PSD for Greenhouse Gases, 11-5-2010]

[Devices subject to this condition: D70]

D90.3 The operator shall continuously monitor the H₂S concentration of fuel gas before being burned in this device according to the following specifications:

The operator shall use a total sulfur fuel gas analyzer approved by the District to monitor the parameter.

The operator shall also install and maintain a device to continuously record the parameter being monitored.

The operator may monitor the H₂S concentration at a single location for fuel combustion devices, if monitoring at this location accurately represents the concentration of H₂S in the fuel gas being burned in this device.

The operator shall install and maintain a totalizing fuel meter to accurately indicate the amount of fuel being used at the facility.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(b)(2)-Offset, 5-10-1996; RULE 431.1, 6-12-1998]

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[Devices subject to this condition: D28, D38, C46]

- D90.4 The operator shall periodically monitor the composition and HHV of the vent gas from condensate break tank V-137 according to the following specifications:

For the purpose of this condition, 'periodically monitor' shall be defined as source testing within 60 days after the vent from V-132 (D32) has been rerouted to the flare (C46) and once per year thereafter to determine and record the parameter being monitored.

The source test shall be conducted in accordance with AQMD-approved test protocol and test method using EPA TO-15 and ASTM D3588/D1945 for gas composition and HHV, respectively.

The operator shall maintain records in a manner approved by the District to demonstrate compliance with this condition.

The requirement of this condition shall no longer be applicable after two successive annual tests demonstrating the gas composition and HHV remain fixed.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(b)(2)-Offset, 5-10-1996]

[Devices subject to this condition: D32]

- D332.1 The operator shall determine compliance with the CO emission limit(s) by conducting a test at least every five years using a portable analyzer and AQMD-approved test method or, if not available, a non-AQMD approved test method. The test shall be conducted when the equipment is operating under normal conditions to demonstrate compliance with the CO emission limit. The operator shall comply with all general testing, reporting, and recordkeeping requirements in Sections E and K of this permit.

[RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997; RULE 407, 4-2-1982]

[Devices subject to this condition: D31, D35, D70]

E. Equipment Operation/Construction Requirements

E193.X The operator shall operate and maintain this equipment according to the following specifications

The operator shall install and implement programmed logic to automatically shut down drier regeneration by closing valves HV-8052 and HV-8053 within 1 minute in the event that a flame is detected at the drier regeneration vent outlet.

For the purpose of this condition, the presence of a flame at the vent outlet is indicated by an ALARM (20 mA) signal from the ultraviolet/infrared flame detector installed pursuant to D12.X

The operator shall maintain records in a manner approved by the District to demonstrate compliance with this condition.

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[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002]

[Devices subject to this condition: D70]

E336.1 The operator shall vent the vent gases from this equipment as follows:

All PSA purge gases shall be vented to the heater (Device D38) except during emergencies, process upset, startup, or shutdown.

This equipment shall not be operated unless the heater is in full use and has a valid permit to receive vent gases from this equipment.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(b)(2)-Offset, 5-10-1996]

[Devices subject to this condition: D28]

E336.2 The operator shall vent the vent gases from this equipment as follows:

All vent gases shall be vented to the flare (Process 3, System 1).

This equipment shall not be operated unless the flare is in full use and has a valid permit to receive vent gases from this equipment.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(b)(2)-Offset, 5-10-1996]

[Devices subject to this condition: D2, D32]

E336.3 The operator shall vent the vent gases from this equipment as follows:

All vent gases from the buffered packing seals shall be vented to the flare (Process 3, System 1).

This equipment shall not be operated unless the flare is in full use and has a valid permit to receive vent gases from this equipment.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(b)(2)-Offset, 5-10-1996]

[Devices subject to this condition: D4]

E336.4 The operator shall vent the vent gases from this equipment as follows:

The drier regeneration vent shall vent to atmosphere only during periods of drier regeneration. Drier regeneration shall occur no more than once per day.

Venting shall be limited to a maximum period of 8 hours in any day.

Venting shall be permitted only during the daylight hours after sunrise and before sunset.

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The operator shall maintain records in a manner approved by the District to demonstrate compliance with this condition.

[RULE 401, 3-2-1984; Rule 401, 11-9-01; RULE 1714 – PSD for Greenhouse Gases, 11-5-2010]

[Devices subject to this condition: D70]

H. Applicable Rules

H23.2 This equipment is subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
VOC	District Rule	1173

[RULE 1173, 2-6-2009]

[Devices subject to this condition: D52, D55, D56]

K. Record Keeping/Reporting

K67.X The operator shall keep records, in a manner approved by the District, for the following parameter(s) or item(s):

For the purpose of this condition, the parameter(s) or item(s) below shall be continuously recorded at least once per minute.

The position of valves HV-8052 and HV-8053. Any changes to the positions of valves HV-8052 and HV-8053 shall also be recorded.

For the purpose of this condition, an active drier regeneration event is indicated by the open position of either valve(s) HV-8052 or HV-8053.

The highest output signal received from the UV/IR flame detector, in mA, within any one minute during the venting cycle of any drier regeneration event.

Records shall be submitted to the District (attn.: Patrick Lee, AQ Engineer) within 30 days after completing two (2) consecutive drier regenerations, post construction of the two additional compressors and two additional stanchions.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002; RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997]

[Devices subject to this condition: D70]